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IS : 11184 - 1984

Indian Standard

SPECIFICATION FOR
ENAMELLED AND VARNISH
BONDED GLASS FIBRE COVERED
ROUND COPPER WIRES

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

SPECIFICATION FOR ENAMELLED AND VARNISH BONDED GLASS FIBRE COVERED ROUND COPPER WIRES

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AMENDMENT NO. 1 JULY 1990
TO
IS : 11184 - 1984 SPECIFICATION FOR
ENAMELLED AND VARNISH BONDED GLASS
FIBRE COVERED ROUND COPPER WIRES

(*Page 7, clause 6.5*) — Substitute the following for the existing clause:

'The wires shall meet the requirements when tested at room temperature and at rated temperature as mentioned in 6.5.1, 6.5.2 and 6.5.3. At least four out of five samples shall meet the requirements given in Tables 3 and 4 respectively for test at room temperature and at rated temperature and fifth sample shall meet at least 50 percent of the specified values given in Tables 3 and 4 respectively.'

(*Page 8, Tables 3 and 4*) — Substitute the following for the existing headings of the tables:

**'TABLE 3 BREAKDOWN VOLTAGE OF ENAMELLED AND GLASS FIBRE
COVERED WIRES AT ROOM TEMPERATURE**

**TABLE 4 BREAKDOWN VOLTAGE OF ENAMELLED AND GLASS FIBRE
COVERED COPPER WIRES AT RATED TEMPERATURE'**

Indian Standard
**SPECIFICATION FOR
ENAMELLED AND VARNISH
BONDED GLASS FIBRE COVERED
ROUND COPPER WIRES**

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 26 November 1984, after the draft finalized by the Winding Wires Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard covers the requirements and test methods of enamelled and varnish bonded glass fibre lapped round copper wires. The requirements of enamelled and varnish bonded glass covered rectangular copper wires are covered in IS:10114-1982*.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS:2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard relates to round copper wires coated with enamel and covered with single or double glass fibre lapped, bonded with a suitable highly polymerised thermosetting varnish. The wires covered by this standard are suitable for temperature index 130, 155, 180 and 200. The type of enamel and varnish shall be based on the temperature index of the wire required by the purchaser.

1.2 Sizes — The requirements of this standard are applicable to conductors having diameters 0.800 mm to 4 000 mm. A schedule of preferred sizes of round conductor is given in Table 1 of IS:4800 (Part I)-1968‡.

*Specification for enamelled and varnish bonded glass fibre covered rectangular copper wires.

†Rules for rounding off numerical values (*revised*).

‡Specification for enamelled round winding wires: Part I Conductors data.

1.3 Grades of covering specified are given below:

- | | |
|--------------------|----------------|
| a) Enamel covering | Medium — E_1 |
| b) Glass covering | Single — G_1 |
| | Double — G_2 |

Grades of enamelled and glass fibre covered copper wires will be denoted as E_1G_1 and E_1G_2 .

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Wire — The insulated material as received.

2.2 Conductor — The bare metal after removal of both enamel and glass covering.

2.3 Crack — A crack is an opening in the fibre glass insulation which exposes the substrate to view to normal eyesight.

2.4 Increase in Dimensions Due to Covering

2.4.1 *Due to Enamel Covering* — The difference between diameter over enamel insulation and diameter of conductor.

2.4.2 *Due to Glass Fibre* — The difference between the diameter over glass fibre varnish bonded covering and the diameter over enamel insulation.

3. GENERAL TEST CONDITIONS

3.1 Unless otherwise specified, all tests shall be carried out within a temperature range of 15 to 35°C and a relative humidity ranged 45 to 75 percent. Before measurements are made, the specimen shall be preconditioned under these atmospheric conditions for a time sufficient to allow specimen to reach stability.

3.2 The wire to be tested shall be removed from the packaging in such a way that the wire will not be subjected to tension or unnecessary bends.

3.3 Before each test sufficient wire shall be discarded to ensure that any damaged wire is not included in the test specimen.

3.4 When no specific range of sizes is given for a test, the test is applicable to all sizes.

4. GENERAL REQUIREMENTS

4.1 Conductor — The conductor shall fully conform to IS:4800 (Part I)-1968*.

4.2 Glass Yarn — The glass fibre yarn shall be of a quality suitable for electrical purposes and shall be continuous filament containing not more than 1 percent alkali calculated as sodium oxide (Na_2O).

4.2.1 When tested in accordance with 9 and 10 of IS:5596-1970†, the pH value of water extract of the yarn before its application on the conductor shall be between 8 and 10.

5. ENAMELLED CONDUCTOR

5.1 The enamelled wire shall meet the requirements given in the relevant part of IS:4800.

NOTE — To carry out tests on enamelled wire it is always preferred to call for only enamelled wire without any glass covering from the supplier otherwise the enamelled wire after removal of glass covering may give erratic results.

6. ENAMELLED AND GLASS FIBRE COVERED VARNISHED WIRE

6.1 Glass Covering — The enamelled conductor shall be covered with single/double layers of glass fibre applied firmly, evenly, closely and continuously round the conductor. The two layers of glass lapping shall be applied in opposite directions. The glass covering shall be firmly bonded with a suitable highly polymerised thermosetting varnish of corresponding temperature index and shall not get unwound on its own when the conductor is cut into pieces. The varnish shall have no adverse effect on the enamel covering.

6.1.1 If it is necessary for manufacturing reasons to apply a hand-lapped covering of glass yarn or untreated glass tape over an interruption in the glass covering, this may be done, provided that the length of made-up insulation does not exceed 100 mm at any one place and that the increase in dimensions due to covering at this repaired point does not exceed twice the mean of the minimum and maximum values specified for the glass of covering in Table 1. The hand lapping shall not be more than one for a length of 25 m of wire and total hand lapping shall not exceed three in 100 m.

6.2 Increase in Dimensions Due to Glass Covering — The increase in dimensions due to glass covering shall conform to the values of Table 1.

*Specification for enamelled round winding wires: Part I Conductors data.

†Method of test for determining deleterious substances in fibrous insulating materials.

**TABLE 1 DETAILS OF INCREASE IN DIAMETER DUE
TO INSULATION OF FIBREGLASS LAPPING
AND VARNISH BOUNDING**

(Clauses 6.1.1 and 6.2)

All dimensions in millimetres.

NOMINAL CONDUCTOR DIAMETER		SINGLE GLASS FIBRE COVERING G_1		DOUBLE GLASS FIBRE COVERING G_2	
Over	Up to and including	Min	Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)
—	2.000	0.085	0.125	0.150	0.200
2.000	3.350	—	—	0.200	0.250
3.350	4.000	—	—	0.250	0.300

NOTE — The wire may be supplied with enamel and glass covering thickness other than specified by mutual agreement. In that case the overall diameter shall not exceed maximum conductor diameter + maximum enamel insulation + maximum glass fibre covering.

6.2.1 Method of Measurement — Take about one metre sample and if necessary straighten the sample by elongating in a tensile testing machine; the sample shall not be elongated more than 1 percent. Take readings of overall diameter at five different places and calculate average value.

6.3 Flexibility

6.3.1 Before Heat Ageing — Samples of enamelled and glass covered wire as received shall be wound for ten continuous turns around a polished metal mandrel having a diameter equal to 10 times the nominal conductor diameter. The mandrel diameter shall not vary by more than ± 10 percent and sufficient tension shall be used to give even and compact layer, when so tested, the covering shall not open sufficiently to expose the enamelled conductor to view when examined under diffused light with normal eyesight. There shall be no appreciable loosening of the insulation.

6.3.2 After Heat Ageing — Prebent samples as done in 6.3.1 shall be heated for 24 hours in a natural up draught air oven (2-3 changes per hour) at a temperature corresponding to the temperature index of the wire as given in Table 2 and finally allowed to cool down to room temperature. The specimen shall not show splitting to covering or sufficient opening in the covering to expose substrate to view under diffused light under normal eyesight.

TABLE 2 HEAT AGEING TEMPERATURE

(Clauses 6.3.2 and 6.4)

TEMPERATURE INDEX OF THE SYSTEM	HEAT AGEING TEMPERATURE °C
(1)	(2)
130	150-155
155	175-180
180	200-205
200	220-225

6.4 Test for Tackiness — If agreed between the supplier and the user sample shall be subjected to this test. A sample of enamelled and glass fibre covered varnish bonded copper wire shall be kept into a hot electrically heated natural up draught air oven having a temperature of 65°C or as agreed between the supplier and the user for 10 minutes. The glass fibre covering after removal of the sample from the oven shall not become tacky to touch.

6.5 Breakdown Voltage — The wire shall meet the requirements of 6.6.1 and 6.6.2 of IS:10114-1982* when tested at room temperature and at elevated temperature, respectively except for A-1, A-2.1 and A-3.1 which may respectively be read as 6.5.1, 6.5.2 and 6.5.3 as given below for enamelled and varnish bonded glass fibre covered round copper wires. Five tests shall be carried in each case. At least four out of the five samples shall meet the requirements given in Table 3 and Table 4 respectively for test before heat ageing and after heat ageing and fifth sample shall meet at least 50 percent of the specified values given in Table 3 and Table 4, respectively.

6.5.1 The test voltage shall be alternating and of a nominal frequency of 50 Hz and approximately sinusoidal, the peak factor being within the limits of $\sqrt{2} \pm 5$ percent (1.34 to 1.48). The test transformer should have a rating of at least 500 VA and should provide a current of essentially undistorted wave form under test conditions.

6.5.2 A specimen of wire 350 mm long shall have the insulation removed at one end and be bent around a mandrel having the diameter of 50 mm for wires with diameters up to and including 2.5 mm and 100 mm for wires with diameter over 2.5 mm.

*Specification for enamelled and varnish bonded glass fibre rectangular copper wires.

6.5.3 Specimen prepared as described in 6.5.2 and the metal container to be used for test alongwith metal shots as described in A-2.2 of IS:10114-1982* shall be pre-heated to the temperature class of the wire separately in an air-circulated oven.

TABLE 3 BREAKDOWN VOLTAGE OF ENAMELLED AND GLASS FIBRE COVERED COPPER WIRES

(Clause 6.5)

NOMINAL CONDUCTOR DIAMETER, mm		BREAKDOWN VOLTAGE (VOLTS) <i>Min</i> GLASS FIBRE COVERING GRADE	
Over	Up to and Including	E ₁ G ₁	E ₁ G ₂
(1)	(2)	(3)	(4)
—	0.850	1400	1750
0.850	0.950	1500	1850
0.950	1.120	1550	1900
1.120	1.320	1600	1950
1.320	1.600	1650	2000
1.600	4.000	1700	2200

TABLE 4 BREAKDOWN VOLTAGE OF ENAMELLED AND GLASS FIBRE COVERED COPPER WIRES (AFTER HEAT AGEING)

(Clause 6.5)

NOMINAL CONDUCTOR DIAMETER, mm		BREARDOWN VOLTAGE (VOLTS) <i>Min</i> GLASS COVERING GRADE	
Over	Up to and Including	E ₁ G ₁	E ₁ G ₂
(1)	(2)	(3)	(4)
—	0.850	1050	1100
0.850	0.950	1100	1150
0.950	1.120	1150	1200
1.120	1.320	1200	1250
1.320	1.600	1250	1300
1.600	4.000	1300	1350

*Specification for enamelled and varnish bonded glass fibre rectangular copper wires.

6.6 Thermal Endurance Test — Under consideration.

7. PACKING AND MARKING

7.1 The wire shall be wound on drums, packed, wrapped and labelled in accordance with IS:482-1981*.

The wire shall be protected against possible damage from the inner faces of the flanges of the reels by lining each flange with thick paper or plastic sheet.

7.1.1 The label which is to be securely attached to reel shall have the following information:

- a) Manufacturer's name or trade-mark,
- b) Grade of glass covering,
- c) Class of insulation (temperature index),
- d) Conductor diameter,
- e) Net weight of the wire,
- f) Tare weight of the reel, and
- g) Batch/Lot No.

7.2 The label may also be marked with the ISI Certification Mark.

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*Specification for reels for covered, round electrical winding wires (*third revision*).

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INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>	<i>Definition</i>
Force	newton	N	1 N = 1 kg. m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²

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